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# Detecting "Bad" Leverage

Amir Sufi

## 14.1 Introduction

The key question I seek to answer in this chapter is the following:

How do regulators and policymakers know when a large increase in leverage will end badly?

A large body of evidence suggests that the sharp increase in household debt during the years prior to the Great Recession of 2007 to 2009 was perhaps the most important factor explaining the severity of the downturn.[1] Seeing this sharp increase in household debt during the housing boom was not difficult. Instead, the difficulty was determining whether regulators and policymakers should be concerned about the increase.

My analysis seeks to answer the following question: How does a regulator know when a large increase in household debt will end badly? I argue that the answer to this question lies in the ability to detect whether an increase in household leverage is due to an expansion in the *supply* of credit or whether it is due to improvements in the *productivity* of borrowers. The essence of the strategy I propose is to use microeconomic data on borrowers with a high elasticity of borrowing with respect to credit availability to isolate the supply

1. See, for example, Mian and Sufi (2010, 2011), Glick and Lansing (2010), and Hall (2011).

versus productivity effects. If a sharp increase in leverage is due primarily to an increase in the *supply* of credit, the regulator should be concerned. While I focus here on the household sector, the approach I describe could easily be applied to other sectors, such as nonfinancial corporations or banks.

Three preliminary facts will help motivate the methodology. First, when fueled by an expansion in the availability of credit, dramatic increases in leverage typically end badly. Kindleberger and Aliber (2005) conducts a careful historical analysis of financial crises and argues that they are often preceded by the "expansion of credit result[ing] from the development of substitutes for what previously had been traditional monies." My assertion is that serious dangers lurk when financial innovation leads to a sharp increase in debt levels that are unaccompanied by improvements in borrowers' permanent income or productivity.[2]

Second, there is a segment of the US population that displays a very high elasticity of borrowing with respect to credit availability. This has been shown in a variety of contexts including credit cards (Gross and Souleles 2002), home equity loans (Mian and Sufi 2011), and auto loans (Einav, Jenkins, and Levin 2011). The aggressiveness shown by borrowers is notable: in my joint work with Atif Mian, we show that borrowers in the lowest quartile of the credit rating distribution borrow up to $0.40 for every $1.00 of increase in home equity.

Third, asset prices are often a function of debt levels. There are both theoretical (e.g., Allen and Gale 2000; Geanakoplos 2010; Simsek 2011) and empirical studies (Mian and Sufi 2009; Favara and Imbs 2010) that support this view. As a result, debt-to-value ratios are often misleading in the midst of an expansion in debt. A critical mistake is to justify high levels of debt with an appeal to high asset values. If the expansion of debt is causing the increase in the value, the higher values will likely prove to be temporary.

These three facts are important to keep in mind as I outline the methodology.

## 14.2    The Methodology

The methodology I propose is as follows.[3] Conditional on seeing a sharp increase in leverage in some sector of the economy, use microeconomic data to implement the following three steps:

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2. This is, of course, a controversial assertion. However, it is supported by evidence from a variety of sources, including Kindleberger and Aliber (2005), Eichengreen and Mitchener (2003), Mian and Sufi (2009), and Schularick and Taylor (2009). There is an indisputably strong predictive relation between sharp increases in debt and subsequent financial crises. I do not take a stand on the underlying model that is consistent with this relation. While I fully agree that more research on this issue is needed, I believe the evidence is strong enough to warrant careful monitoring of debt levels in the economy.

3. A simple model to motivate this test is in Mian and Sufi (2009).

1. Determine who the marginal borrowers are that have a very high elasticity of borrowing with respect to credit availability. Ideally, one wants to classify marginal borrowers before the large increase in debt. These borrowers will often appear "constrained" from receiving credit before the increase in leverage.

2. Ask the question: During the period of increasing debt levels, has the flow of credit to these marginal borrowers increased substantially relative to nonmarginal borrowers? Or in other words, are previously constrained borrowers responsible for a large fraction of the total increase in debt levels? In most circumstances where debt levels have increased sharply, the answer to this question will be yes.

3. If the answer to the previous question is yes, ask the question: Is the relative increase in the flow of credit to marginal borrowers driven by productivity improvements/increases in permanent income? Use current income growth as a proxy. This is the key step in the methodology and requires the most careful analysis.

If the answer to question 2 is yes and the answer to question 3 is no, then the evidence is supportive of credit supply as the driving force behind increases in debt levels. My assertion is that the regulator should show some concern if this is the case.

I do not take a stand on the precise steps that the regulator should take at that point in time. It will depend on the circumstances and the overall economic environment. But it is critical for the regulator to understand when sharp increases in debt levels are likely driven by an expansion in the willingness to lend by creditors, and not by improvements in productivity or permanent income.

## 14.3 An Example: The 2002 to 2007 Increase in US Household Debt

Figure 1 in the online appendix shows the sharp rise in household debt in the United States beginning in about 2000. While there was a general increase in household debt since the 1950s, the increase in debt from 2000 to 2007, measured either as a total or scaled by income, was stunning in historical perspective. Witnessing this sharp rise in household debt in real time, the regulator would now be in a position to implement the above-mentioned methodology.

The first step is to isolate marginal borrowers. I examine two measures used in the previous literature (Gross and Souleles 2002; Mian and Sufi 2009): the credit card utilization rate and the fraction of borrowers with a credit score under 660. I measure these variables at the zip code level as of 1998. In figure 2 in the online appendix, I show the correlation of these two variables with denial rates on mortgage applications as of 1998. Both of these measures were strongly correlated with the denial rate, which is consis-

tent with the view that these measures capture "constrained" or "marginal" households.

For step 2, I measure the flow of credit to these marginal borrowers using new mortgage originations for house purchase. I split the sample of zip codes based on the fraction of individuals with a credit score below 660 as of 1992. In figure 3 in the online appendix, I show the growth in mortgage originations for house purchase from 1992 through 2009. As figure 3 shows, there was a dramatic relative growth in originations for zip codes with a large fraction of marginal borrowers, as measured by credit score. This corresponded closely to the period in which aggregate household debt levels increased sharply. The answer to the question in step 2 is yes: the sharp increase in overall household debt corresponded to a dramatic relative increase in the flow of credit to marginal borrowers.

For step 3, I measure relative income growth for marginal versus nonmarginal borrowers. Figure 4 in the appendix shows income growth for high- versus low-credit quality zip codes. From 2002 to 2007—the period in which the relative growth in mortgage credit to low-credit quality zip codes was strongest—there was no evidence that low-credit quality zip codes experienced substantial gains in income. If anything, the opposite is true: marginal borrowers in the United States from 2002 to 2007 were experiencing a tremendous growth in mortgage credit while experiencing lower income growth relative to nonmarginal borrowers.

If the above-mentioned methodology had been implemented during the 2000 to 2007 explosion in US household debt, it would have been clear that the sharp increase was driven primarily by an expansion in the credit supply. This could have been seen as early as 2004 and very strongly in 2005.

## 14.4    Additional Notes on Methodology

*The methodology explicitly ignores asset prices.* It compares the flow of credit to marginal households with their income growth, but does not take into account the increase in the value of the asset being financed (in the case of 2000 to 2007, house prices). The justification for ignoring asset prices is that they are often a function of debt availability. In the context of the 2000 to 2007 credit expansion, figure 5 in the appendix shows that house prices increased by more in zip codes with a larger fraction of low-credit quality borrowers. This relative growth in house prices occurred despite the fact that income growth in these areas was relatively negative. Indeed, perhaps the biggest mistake made by regulators in the household debt run-up was to justify debt levels with high house prices, when high debt levels were likely pushing up house prices.

*The methodology also explicitly ignores interest payments on debt.* Expansions in credit correspond with declines in interest rates, and so a compari-

son of income to interest rates ("debt service ratio") can hide the danger of higher debt levels. This was especially true from 2002 to 2007 when lower interest payments were driven in part by teaser rates on adjustable-rate mortgages that depended on continued house price growth. Further, it is likely that the level of debt will be the biggest problem in a financial crisis (given debt overhang or risk-shifting tendencies), not the flow of interest payments to creditors.

*This methodology is about aggregate patterns.* A mistaken view is that this exercise only isolates patterns among marginal borrowers. Instead, the methodology uses marginal borrowers to make an assertion about what is driving aggregate economic patterns. If the flow of credit to marginal borrowers expands dramatically despite lower relative income growth, it is likely that the increase in debt levels even for nonmarginal borrowers is driven by credit supply. In appendix figure 6, I present a scatter plot of US states that supports this view. On the horizontal axis, I calculate for each state the zip code level correlation between low-credit quality share and mortgage origination growth from 2002 to 2006. States with a high score on this measure are states where the credit supply effect is strongest. On the vertical axis, I plot the total household debt growth over the same time period. As the figure shows, there is a very strong positive relation between overall debt growth in a state and the relative flow of mortgage credit to marginal borrowers.

*Microeconomic data is critical.* The aggregate debt-to-income ratio is a useful measure. But the nature of the income process at the aggregate level can lead regulators to discount a sharp increase in the debt-to-income ratio. For example, many regulators argued that productivity improvements led to a rise in long-run permanent income that justified higher debt levels relative to current income. The microeconomic data show explicitly that debt levels are rising in areas where income is not rising. The microeconomic data force regulators to understand the reasons why marginal borrowers are building up debt without any evidence of an increase in permanent income.

*This methodology applies to other sectors of the economy.* I focus here on the household sector, but this methodology can be implemented in other sectors easily. For example, Greenwood and Hanson (2010) implement a very similar test in the context of nonfinancial businesses. They show that a relative increase in credit to highly levered risky companies is followed by lower expected returns on bonds. In fact, they argue that expected returns on bonds are negative after sharp increases in credit to marginal borrowers on the corporate side.

*Good shifts in credit supply?* More evidence is needed to buttress the assertion that all shifts in credit supply end badly. Are there episodes in the past in which a shift in credit supply unaccompanied by productivity improvements did not end badly?

*But what about the economics?* I am very sympathetic to the complaint

that we need to understand more about the underlying economics of credit expansion to marginal borrowers before implementing the methodology. For example, under a simple model of liquidity constraints, the consumer welfare improvements of credit expansion to marginal borrowers are large. But I believe it is equally important to give serious considerations to models in which debt amplifies negative shocks (e.g., Bernanke and Gertler 1989; Shleifer and Vishny 1992; Kiyotaki and Moore 1997; Krishnamurthy 2003; Allen and Gale 2004) and models that argue that debt levels can be inefficiently high (e.g., Lorenzoni 2008). Given the ambiguity on the ultimate welfare costs of intervention, I have purposely not recommended any specific intervention upon determining the importance of credit supply shifts in the economy.

## 14.5  Data

In terms of data, one advantage of the methodology is that it can be implemented immediately. In fact, most of the data for this exercise is available at the zip code level. Regulators can potentially construct a zip code data set to implement this approach going forward without requiring any additional surveys or data collection.

In order to construct the ideal data set, I will first list the existing data sources available at the zip code level. I will then highlight where more data is needed.

- Home Mortgage Disclosure Act. This provides excellent data on the flow of new mortgages. This is available at the individual application level, and can easily be aggregated to the census tract or zip code level. The frequency is yearly.
- Consumer Credit Bureau data. This provides excellent data on the debt side of the household balance sheet. These data could be broken down to the individual level, but are also widely available at the zip code level. The frequency is monthly.
- House price data. Data on house prices at the zip code level are available from Fiserv Case Shiller Weiss, CoreLogic, and Zillow. The frequency is monthly.
- IRS income data. The IRS Statistics of Income provides income data aggregated to the zip code level. The frequency is yearly.
- Auto sales data. Auto purchases at the zip code level are available from R. L. Polk. The frequency is monthly.
- Census. The decennial census provides a wealth of information at the zip code level. The primary drawback is that the information is only provided every ten years. But this snapshot is extremely valuable for understanding the microeconomic patterns behind macroeconomic trends.

In terms of improvements in data, I would emphasize the following:

- Data on consumption is very limited. The auto sales data is the only measure of consumption that I know of that is at the zip code level. One obvious source of such data would be credit card companies and the clearing houses. They should have data at the zip code level. Monitoring consumption levels is crucial for understanding how leverage is affecting the economy.
- Data on wealth is also very limited. The most commonly used source is the Survey of Consumer Finances. The drawback is that geographic identifiers are not widely available, and the sample is quite small. One possible source is IXI Corporation, which may have microdata available on the wealth distribution.
- The IRS data has a huge lag. If the IRS made their zip code–level data available more quickly, that would facilitate measurement. As of August 2011, the latest zip code–level IRS data available is for 2007.
- While zip code–level data is very useful for understanding what is happening in the economy, individual-level data is needed in some circumstances. One of the most important individual-level characteristics that is needed is whether someone owns a home or not. Being able to split home owners and renters and examine their patterns separately would be extremely useful.

## References

Allen, Franklin, and Douglas Gale. 2000. "Bubbles and Crisis." *Economic Journal* 110:236–55.

———. 2004. "Financial Intermediaries and Markets." *Econometrica* 72:1023–61.

Bernanke, Ben, and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79 (1): 14–31.

Eichengreen, Barry, and Kris Mitchener. 2003. "The Great Depression as a Credit Boom Gone Wrong." Bank for International Settlements Working Paper no. 137. http://www.bis.org/publ/work137.htm.

Einav, Liran, Mark Jenkins, and Jonathan Levin. 2011. "Contract Pricing in Consumer Credit Markets." Working Paper, Stanford University.

Favara, Giovanni, and Jean Imbs. 2010. "Credit Supply and the Price of Housing." Working Paper, International Monetary Fund.

Geanakoplos, John. 2010. "The Leverage Cycle." In *NBER Macroeconomics Annual 2009*, edited by Daron Acemoglu, Kenneth Rogoff, and Michael Woodford, 1–65. Chicago: University of Chicago Press.

Glick, Reuven, and Kevin Lansing. 2010. "Global Household Leverage, House Prices, and Consumption." *FRBSF Economic Letter*, Jan 11. San Francisco: Federal Reserve Bank of San Francisco.

Greenwood, Robin, and Samuel Hanson. 2010. "Issuer Quality and Corporate Bond Returns." Working Paper, Harvard Business School, Harvard University.

Gross, David, and Nicholas S. Souleles. 2002. "Do Liquidity Constraints And Inter-

est Rates Matter For Consumer Behavior? Evidence from Credit Card Data." *Quarterly Journal of Economics* 117 (1): 149–85.

Hall, Robert. 2011. "The Long Slump." *American Economic Review* 101 (2): 431–69.

Kindleberger, Charles P., and Robert Aliber. 2005. *Manias, Panics, and Crashes: A History of Financial Crises*. Hoboken, NJ: John Wiley & Sons.

Kiyotaki, Nobuhiro, and John Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105 (2): 211–48.

Krishnamurthy, Arvind. 2003. "Collateral Constraints and the Amplification Mechanism." *Journal of Economic Theory* 119:104–27.

Lorenzoni, Guido. 2008. "Inefficient Credit Booms." *Review of Economic Studies* 27:809–33.

Mian, Atif, and Amir Sufi. 2009. "The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis." *Quarterly Journal of Economics* 124:1449–96.

———. 2010. "Household Leverage and the Recession of 2007 to 2009." *IMF Economic Review* 58:74–117.

———. 2011. "House Prices, Home Equity-Based Borrowing, and the US Household Leverage Crisis." *American Economic Review*, August.

Schularick, Moritz, and Alan Taylor. 2009. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008." NBER Working Paper no. 15512, Cambridge, MA.

Shleifer, Andrei, and Rob Vishny. 1992. "Liquidation Values and Debt Capacity: A Market Equilibrium Approach." *Journal of Finance* 47:1343–66.

Simsek, Alp. 2011. "Belief Disagreements and Collateral Constraints." Working Paper, Massachusetts Institute of Technology.